

Biomaterials: Form and Function



Key Opportunities:

1. Micro- and nano-structural materials with reproducible properties (\AA to μm scale).
(nanolasers, ordered microfilaments and films, precision particulate filters, phased array emitters, hybrid functional materials)

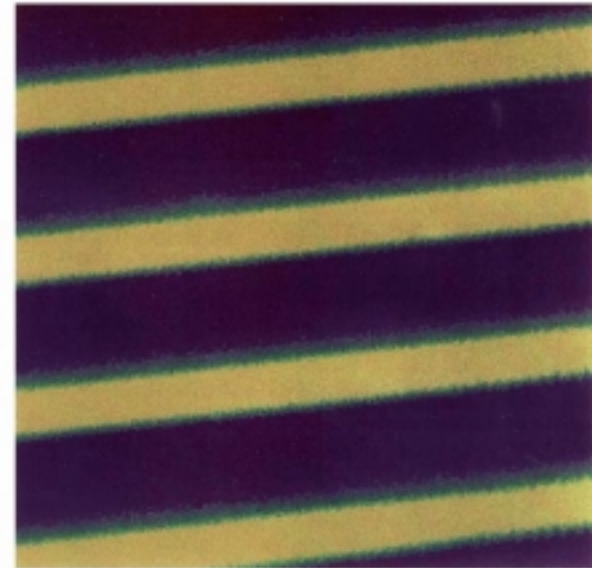
Defense Implications:

Enhanced electromagnetic and structural performance

2. Biomimetic based sensors. (reproduce and enhance natural sensor organs; animal-insect)

Defense Implications:

Situational awareness



nano-lasers

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Key Opportunities (continued):

3. Image recognition, data storage and manipulation using genetically optimized proteins.
(diffraction limited target recognition, high density associative memory, hardened and rugged multigigabyte-terabyte volumetric memory)

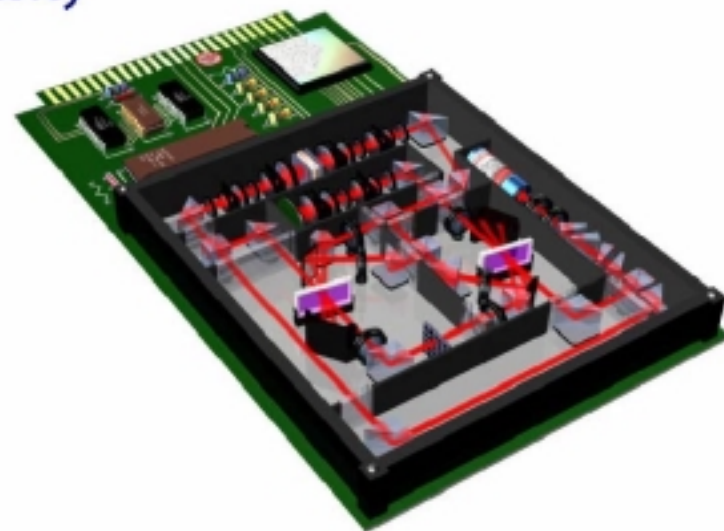
Defense Implications:

Distributed image analysis and data fusion
(network-centric capability)

4. Self-repairing systems. (clothing, digital memories, sensors, helmets, artificial skins & bones, smart skins).

Defense Implications:

"Zero"-maintenance systems



**Protein-based
Fourier-transform
associative memory**

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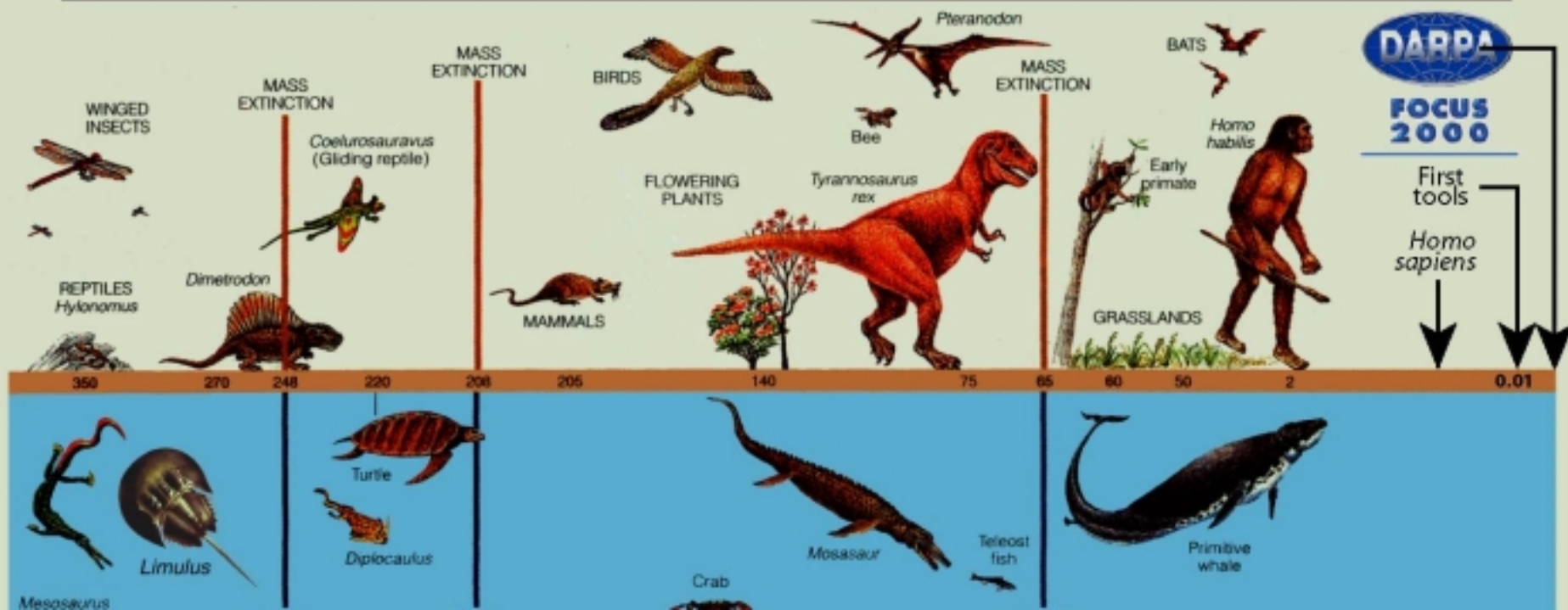
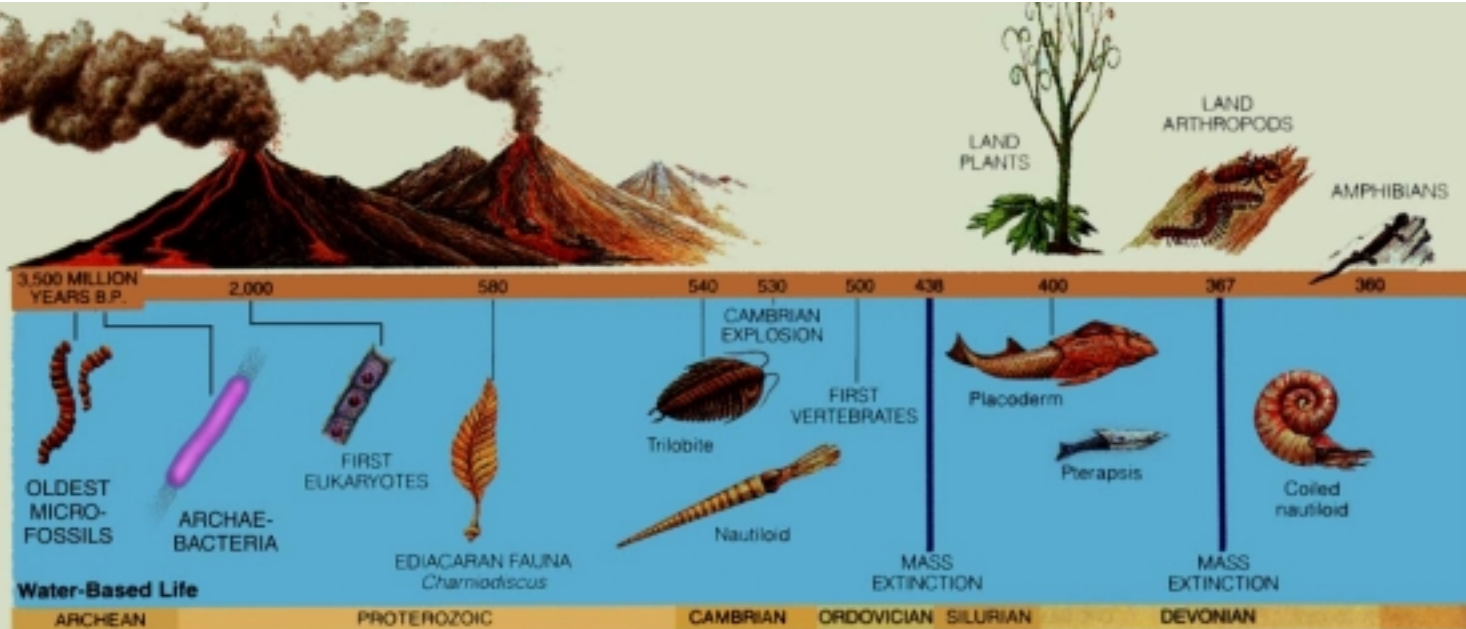
Technical Enablers:

1. Biomimetics
2. Biophotonics and bioelectronics
3. Designed combinatorial libraries
4. Directed evolution
5. Biosynthesis and amplification
6. Computer modeling of biomolecules helps direct mutagenesis

Technical Barriers:

1. Genetic selection for the desired properties is difficult and has no apparent global solution
2. Theoretical modeling of biomolecules is still unreliable
3. Self assembly is difficult to control in most real situations
4. Most native biological molecules are light and heat labile

**Nature has already
created through
natural selection
more successful
materials than the
totality of all human-
made materials-
and most of these
have yet to be
discovered**



FOCUS 2000

First tools

Homo sapiens